TECHNICAL MANUAL

USE AND QUALITY CONTROL

DEMINERALIZED WATER AND WATER-ALCOHOL MIXTURES FOR AIRCRAFT ENGINES

(ATOS)

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INTRODUCTION

1. PURPOSE.

The purpose of this technical manual is to provide technical guidance for utilizing demineralized water and water-alcohol mixtures in aircraft engines. In any instance of conflict between these instructions and those contained in the specific aircraft flight manual, the instructions in the flight manual shall take precedence, and any conflicting instructions will immediately be brought to the attention of the MAJCOM Fuels Officer and DET 3, WR-ALC/AFTT, Wright-Patterson AFB, OH 45433-7632, DSN 785-8050.

2. SCOPE.

The scope of this technical manual includes requirements for production of demineralized water, and the mixing, testing, storage, quality surveillance, and servicing of demineralized water and water-alcohol mixtures to aircraft.

CHAPTER 1
GENERAL

1.1 APPLICATION.

a. This manual presents data governing the proper utilization of demineralized water as a thrust augmentation medium in turbojet engines and water-alcohol mixtures as an anti-detonation (internal coolant) medium in reciprocating aircraft engines.

b. This manual also defines the tests and testing procedures required of USAF activities to assure quality surveillance of distilled or demineralized water and water-alcohol mixtures.

c. Initial testing as outlined in this manual will be performed by base-level fuels laboratories. Sampling will be accomplished by either laboratory personnel or operating personnel under laboratory supervision. Necessary laboratory equipment to perform the required testing will be procured In Accordance With (IAW) provisions of TA-460. Additional testing which may be required for correlation or confirmation can be obtained from any of the laboratories listed in Table 4-1.

1.2 STORAGE AND SERVICING EQUIPMENT.

a. All precautions will be taken to insure that storage and servicing equipment tanks are maintained in a condition that will preclude contamination of the product by dirt, impure water, or other foreign matter that could render the product unsuitable for use.

b. In the event of malfunction or failure of cited equipment, the appropriate Inventory Manager of equipment involved should be contacted for any possible technical guidance that may be available.

CHAPTER 2
WATER AND WATER-ALCOHOL IN AIRCRAFT ENGINES

2.1 WATER PURITY.

The water used for the purpose described herein must be clear and free of harmful impurities. Some waters which are suitable for human consumption are undesirable for use in water injection systems since they contain a relatively high concentration of dissolved minerals which will deposit as scale on internal engine parts, water regulator passages, solenoid valves, etc., and consequently will reduce engine efficiency. Waters having a total solids concentration of not more than 10 parts per million (ppm) are considered suitable for use in water injection systems of all aircraft. Such water may be obtained by distillation or by chemical demineralization. Information on the analysis of water can generally be obtained from local water works officials, public health offices, or educational institutions. If civilian information relative to the pH or total solid content of local water supply cannot be obtained from sources mentioned above, a 1-pint sample of the water in a clean glass or plastic container well rinsed with water from the same source as the sample, will be forwarded to an Aerospace Fuels Laboratory listed in Table 4-1. Overseas locations should submit samples to the nearest government-operated or contract Petroleum Products Testing Laboratory for such analysis.

2.2 STRAIGHT WATER APPLICATIONS FOR TURBOJET AIRCRAFT.

2.2.1 Water Requirements. Turbojet engines in present, active USAF aircraft that require water for thrust augmentation should be serviced with water that meets the following requirements:

- Total Solids — 10 parts per million (ppm) maximum
- pH range — 5.5 – 9.5

2.2.2 Substandard Water. In situations when water cannot be obtained within these limits, it may be used as follows:

a. Water with pH outside the above limits may be used on a maximum of three occasions per engine provided that parent command headquarters coordination is obtained prior to use, and the engines are liquid cleaned according to T.O. 2J-J57-56 immediately after each occurrence.

b. Water with total solids from 11 – 25 ppm may be used on three occasions provided the engines are subjected to field cleaning according to T.O. 2J-J57-56 immediately after each occurrence.

c. Water with total solids from 26 – 50 ppm may be used on one occasion provided the engines are subjected to field cleaning according to T.O. 2J-J57-56 after its use.

d. Any time water in excess of the pH range of 5.5 – 9.5 and/or total solids of 10 ppm is used, each occurrence shall be noted on the AFTO Form 781 and on the AFTO Form 95 for each engine. Report to parent command headquarters any engine that has reached the limits of exposure to substandard water (three occasions for pH outside 5.5 – 9.5, three occasions for solids 11 – 25 ppm, one occasion for solids 26 – 50 ppm).

e. No further utilization in excess of these limits is authorized between engine overhaul, except in war operations and in emergency to prevent hazard to aircraft safety. After each occasion the engines are to be cleaned according to T.O. 2J-J57-56, as appropriate.

2.2.3 Low Ambient Temperatures. When ambient temperatures below 5°C (40°F) exist, water will not be used in aircraft that do not incorporate a system to heat the water supply. If temperatures of 1°C (33°F) or below are likely to be encountered in flight, the entire amount of water must be consumed on take-off and initial climb, or the complete system must be drained before flight.

Table 2-1. Water-Alcohol Ratios for Reciprocating Engines (Anti-Detonation or Internal Coolant)

Ambient Air Temperature	Alcohol Specification	Alcohol % Volume	Water % Volume
Above –35°C (–30°F)	A-A-59282 (denatured ethyl alcohol, 99.5% minimum purity)	60 ± 5	40 ± 5
–35°C (–30°F) to –46°C (–50°F)	O-M-232 (Grade A)	60 ± 5	40 ± 5

2.3 WATER-ALCOHOL APPLICATIONS.

WARNING

- Alcohol vapors are toxic and adequate ventilation must be provided in areas where alcohol is handled. Never work in a confined space or area without mechanical ventilation or respiratory protection. Alcohols are highly flammable liquids.
- Corrosion preventive soluble oil, Specification MIL-C-4339, is soluble in water, but will not dissolve in alcohol or a premixed water-alcohol mixture. It is imperative that the oil and water be thoroughly mixed before adding alcohol and that all residue of a previous batch be removed from mixing unit before preparing new mixtures. Failure to comply with this warning will result in an unstable and improper mixture, seriously jeopardizing engine performance.

2.3.1 Mixing Instructions. Remove all residue from the previous batch before preparing a new batch. Place the appropriate amount of water conforming to WATER REQUIREMENTS, Paragraph 2.2.1 into the tank. See Table 2-1. Add corrosion preventive soluble oil, Specification MIL-C-4339, in the ratio of 0.67% by volume to the water. This ratio is the same as 2/3 gallons or 2.5 liters of oil for each 100 gallons of water. Blend the mixture thoroughly using the pumps and headers installed on the equipment or use a portable mixer. Mix wetting agent MIL-D-16791, Type I, (95 ml per 100 gallons of final mixture) with the appropriate amount of alcohol. See Table 2-1. Add the alcohol and wetting agent mixture slowly to the water and oil mixture. Blend this mixture thoroughly.

2.3.2 Inspections. Water-alcohol mixtures prepared in this manner should remain stable and usable for at least one year. Improperly prepared water-alcohol mixtures will separate into water-alcohol and oil phases that are readily detected upon visual inspection and shall not be used. Small droplets of oil on the water-alcohol surface are not to be considered cause for rejection. Every 30 days, a sample of the water-alcohol mixture will be drawn from storage or servicing unit and allowed to stand at least one hour in a clear glass bottle to check for oil separation. If separation has occurred, a clear water layer will appear below an oil layer upon standing. This is considered cause for rejection.

2.3.3 Limitations on Use. Aircraft systems shall be drained when ambient temperatures below the recommended temperatures for the particular mixture are anticipated on the ground. If temperatures below those recommended are likely to be encountered in flight, drain the system or consume the entire amount on the take-off and initial climb.

CHAPTER 3
EQUIPMENT

3.1 DEMINERALIZERS TYPES.

a. Demineralizers used by the Air Force are either stationary or portable utilizing two bed or mixed bed ion exchange towers.

b. The demineralizers use ion exchange resins to remove dissolved minerals from raw water, thus producing demineralized water. The demineralizing process proceeds according to the diagrams in Figure 3-1 and Figure 3-2.

c. Figure 3-2 shows regeneration is the reverse of demineralization.

d. Demineralization of water is accomplished by passing raw water through a cation exchange resin that releases hydrogen ions to replace sodium, magnesium, and calcium ions that are retained in the resin bed. Water leaving the cation bed is acid. The acid water is passed through an anion exchange resin that releases Hydroxyl Ions (OH) that neutralizes the water and replaces the sulfates, chlorides, bicarbonates, and silica. The sulfates, chlorides, bicarbonates, and silica are retained in the resin bed and demineralized water is discharge for use.

3.2 PORTABLE DEMINERALIZERS.

3.2.1 Demineralizer, NSN 4610-00-897-7804. Model A-1 portable water demineralizer, NSN 4610-00-897-7804, is a trailer-mounted unit which uses raw water from streams or pools. It contains suction pumps, two weak-base anions, and two cation exchange towers with a demineralized water storage tank. The tank has a 300-gallon capacity. Production rate is 150 gallons of demineralized water per hour with a pH near 6.0 and 1 ppm dissolved solids when the raw water is in the 130 ppm dissolved solids range. This unit will not remove silica.

3.2.2 Demineralizer, NSN 4610-00-886-2364. Portable water demineralizer, NSN 4610-00-886-2364, is a hand-truck-mounted unit designed for storage or shipment aboard C-135 series aircraft. The unit utilizes mixed bed cartridges and will normally produce demineralized water with less than 1 ppm total solids at a pH of 7.0. The production rate of this unit depends upon the source from which raw water is obtained. The unit will remove dissolved silica. Cartridges are not regenerated; they are replaced with new cartridges.

3.2.3 Water Injection Service and Demineralizing Unit. Water injection servicing and demineralizing unit, NSN 4610-00-875-5425, is a self-powered skid-mounted unit with a 250-gallon tap water storage tank. The 250 gallons of tap water are pumped through the unit to the aircraft for servicing. Unit utilizes two mixed bed ion exchange cartridges and produces demineralized water to the aircraft at 1 ppm solids with a pH of 7.0. This unit will remove dissolved silica. The cartridges are not regenerated; they are replaced with new cartridges.

3.3 STATIONARY DEMINERALIZER.

Stationary demineralizer, NSN 4610-00-973-2513, utilizes two single bed ion exchange towers (one anion and one cation). The unit is capable of producing demineralized water at a rate of 1000 gallons per hour (gph) containing a total dissolved solids of 1 ppm. When using a strong base anion exchange resin, the unit will remove dissolved silica.

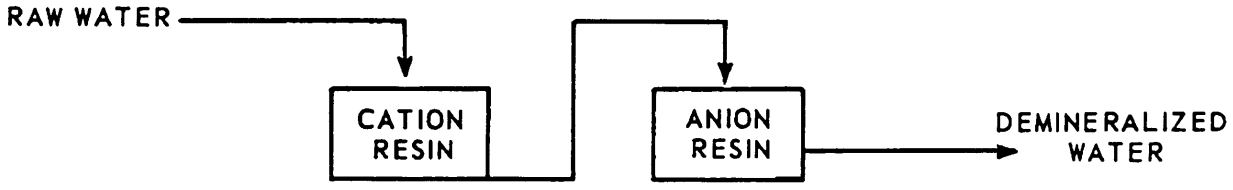

Figure 3-1. Demineralizer Plant Operation

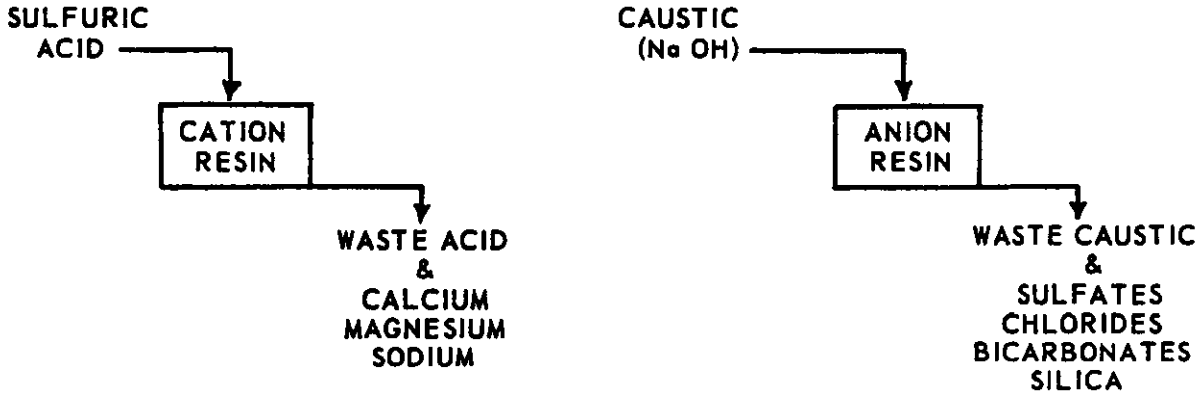

Figure 3-2. Regeneration of Resin Beds

3.4 STORAGE.

Water and water-alcohol mixtures may be stored in rubber or plastic tanks or metal and concrete tanks lined with plastics or rubber. Stainless steels, monel, and inconel metals are highly resistant to corrosion by demineralized water. Unused rubber fuel tanks may be used for storage in emergency or tactical situations.

3.5 MIXING.

a. Water-alcohol mixtures incorporate corrosion preventive soluble oil, Specification MIL-C-4339, as a system corrosion preventive measure. It is essential that the oil be thoroughly mixed with water in the proportions specified in MIXING INSTRUCTIONS, Paragraph 2.3.1 prior to the additions of the alcohol and wetting agent mixture. Water-soluble oil is not soluble in alcohol or a premixed water-alcohol mixture. It is essential that a mixing tank be emptied of all previous water-alcohol mixture prior to starting a new mixture.

b. Water-alcohol mixtures may be mixed directly in the servicing units; the A/S32R-8 truck, MD-3 semitrailer, and ML-1 servicing trailer. The precautions for emptying tanks completely between mixtures, as in stationary blending equipment, apply to servicing unit mixing.

c. Water-alcohol mixing will be accomplished by using equipment mounted pumps or portable mixers.

3.6 AIRCRAFT SERVICING.

a. Demineralized water is serviced into aircraft, using either a 2600-gallon capacity demineralized water truck, Type A/S32A-2 or the A/S32R-8 truck. These trucks are equipped with an aluminum tank with a filter unit ahead of the servicing hose.

b. Water-alcohol mixture is serviced to aircraft using either the A/S32R-8 truck, the 2000-gallon semitrailer, Type MD-3, or a 600-gallon servicing trailer, Type ML-1. These servicing units are equipped with aluminum tanks, mixing headers and pumps, and a filter unit ahead of the servicing hose.

CHAPTER 4
QUALITY CONTROL PROCEDURES

4.1 WATER.

a. Sampling points are as follows:

(1) Fill Stand, Dispensing Line, or Drain Line Representative of the Storage Tank System

(2) Mobile Aircraft Servicing Equipment

b. Samples shall be taken at the following times:

(1) Once Every 7 Days from Each Sampling Point

(2) After Regeneration of the Demineralizer

(3) After Storage Tank Cleaning

(4) After Cleaning the Interior of the Tank on Mobile Servicing Equipment

c. Additional or more frequent testing shall be conducted if the demineralized water is suspected to be off-specification and at the discretion of the Fuels Management Officer. It is recommended that any test result that does not meet the limits specified in WATER REQUIREMENTS, Paragraph 2.2.1 be checked by resampling and testing the source.

d. Correlation samples may be submitted to the area laboratory to check local procedures. Because water is a good solvent, gases and solids will dissolve in it. A sample may pick up gases from the air and matter from the sample bottle during the time of transit to the area laboratory. This will tend to make the correlation unsatisfactory by lowering the pH and raising the total solids. Therefore, special handling procedures which allow the sample to equilibrate with the bottle should be followed. The sample should be drawn, stored for about a week, and shaken occasionally during storage before being analyzed and sent to the area laboratory. CONUS bases should submit samples along with local results to an Aerospace Fuels Laboratory; overseas bases may submit samples along with test results. One-gallon polyethylene bottles (NSN 8125-00-174-0852) may be used.

e. Base laboratory test results on correlation samples should be within the following limits when compared with area laboratory test results:

- Total solids — ±5 ppm
- pH — ±1.5 units

f. When test results are not within these limits, the area laboratory shall not provide the base their results but shall return the sample to the base laboratory for a repeat analysis.

g. Aerospace Fuels Laboratories are listed in Table 4-1.

4.2 ALCOHOL.

WARNING

Alcohols are flammable and they can affect eyes, skin, and respiratory tract. Methyl alcohol is readily absorbed through the skin and direct contact with the eyes can produce serious vision damage. Wear chemical goggles and neoprene gloves when using alcohols and avoid prolonged breathing of vapors. Keep away from sparks and flames.

a. Methyl Alcohol, O-M-232, shall be tested for specific gravity by ASTM hydrometer 84H-62 at 20°C (68°F) before use in water-alcohol mixtures. The ASTM hydrometer 84H-62 has a range of 0.750 – 0.800, graduated in increments of 0.0005. The NSN of the hydrometer is 6630-00-292-0883. A specific gravity reading by this method shall not exceed 0.7939 at 20°C (68°F). A specific gravity greater than 0.7939 is not disqualifying if such a specific gravity is due to water contamination only; samples of suspect lots of methanol shall be sent to a laboratory listed in Table 4-1. If the laboratory confirms that water is the only significant contaminant then special instructions for use will be supplied by DET 3, WR-ALC/AFTT, Wright-Patterson AFB, OH.

b. Denatured ethyl alcohol, A-A-59282 (denatured ethyl alcohol, 99.5% minimum purity), shall be tested for specific gravity by hydrometer method ASTM D287. Specific gravities shall not exceed 0.8160 max at 15.6°C/15.6°C (60°F/60°F). Specific gravities greater than 0.8160 are not disqualifying if due to water contamination only. If an Aerospace Fuels Laboratory (Table 4-1) determines that ethyl alcohol contains excess water, use or disposition instructions will be supplied by DET 3, WR-ALC/AFTT.

Table 4-1. Aerospace Fuels Laboratories

Shipping Address	Mail Address	Telephone Numbers
Aerospace Fuels Laboratory (FP2070) OL DET 3, WR-ALC/AFTLA 2430 C St, Bldg 70, Area B Wright-Patterson AFB, OH 45433-7632	Aerospace Fuels Laboratory OL DET 3, WR-ALC/AFTLA 2430 C St, Bldg 70, Area B Wright-Patterson AFB, OH 45433-7632	Commercial: (937) 255-2106 DSN: 785-2106
Aerospace Fuels Laboratory (FP2075) OL DET 3, WR-ALC/AFTLE 1747 Utah Ave., Bldg 6670 Vandenburg AFB, CA 93437-5220	Aerospace Fuels Laboratory OL DET 3, WR-ALC/AFTLE 1747 Utah Ave., Bldg 6670 Vandenburg AFB, CA 93437-5220	Commercial: (805) 606-6263 DSN: 276-6263/5039
Aerospace Fuels Laboratory (FP2080) OL DET 3, WR-ALC/AFTLF – Bldg 725 Unit 5025 RAF Mildenhall, UK APO AE 09459	Aerospace Fuels Laboratory OL DET 3, WR-ALC/AFTLF Unit 5025 APO AE 09459-5025	Commercial: 44-1-638-54-2043 DSN: 314-238-2043/2797
Aerospace Fuels Laboratory (FP2083) OL DET 3, WR-ALC/AFTLG – Bldg 854 Unit 5161 Kadena AB, Okinawa, JA APO AP 96368-5162	Aerospace Fuels Laboratory OL DET 3, WR-ALC/AFTLG Unit 5161 APO AP 96368-5162	Commercial: 011-81-611-734-1602/3394 DSN: 315-634-1602/3394

4.3 WATER-ALCOHOL MIXTURE.

Each time water-alcohol mixtures are to be dispensed or serviced into aircraft, visually inspect mixtures for signs of separation prior to dispensing. If separation is noted, the water-alcohol solution shall not be used. Small droplets of oil on the surface of the mixture shall not be considered cause for rejection. When in doubt, use the test outlined in INSPECTIONS, Paragraph 2.3.2 to determine oil separation.

4.4 TEST METHODS.

4.4.1 Total Solids. Total solids of demineralized water shall be determined by using the test method in Chapter 5. The total solids test must be accomplished by the approved gravimetric procedure. Accurate results cannot be obtained by using various conductivity meters specifically designed for other tests.

NOTE

The use of pH paper for testing demineralized water must be discontinued. This method is not accurate when analyzing pure (unbuffered) water. The color producing chemicals in the paper will alter the purity of the water significantly so that the color change does not represent the pH of the pure water.

4.4.2 pH Characteristics. The acidity and/or alkalinity (pH) characteristic of demineralized water will be determined on an electric pH meter equipped with glass electrodes. The pH meter authorized in Section B of TA-460, or equivalent meter capable of measuring pH to 0.1 pH point, will meet the requirements of this technical order. The authorized pH meter should be used if at all possible to facilitate uniformity of results among laboratories.

4.4.3 pH Test Procedure. See Chapter 6. Demineralized water may be used for flushing and rinsing the electrodes and sample container, even though the operating instructions specify distilled water.

4.5 STORAGE FACILITIES.

4.5.1 Alcohol. Alcohol stored in bulk storage tanks shall be sampled every 90 days. The 1-quart samples shall be obtained in clean, glass containers. These samples shall be forwarded to an Aerospace Fuels Laboratory to determine their conformance to the applicable Specification O-M-232 or A-A-59282 (denatured ethyl alcohol, 99.5% minimum purity). If the alcohol does not conform to the applicable specification, disposition instructions will be furnished by DET 3, WR-ALC/AFTT.

4.5.2 Water. Demineralized water will be sampled and tested from each water storage tank a minimum of once every 7 days. The sample shall be taken in a clean, plastic bottle from the truck loading facility after first flushing the fill line by allowing at least 5 gallons of water to flow from the line. The water sample will be tested by the base laboratory. Total solids are to be no more than 10 ppm with a desirable level of 3 – 5 ppm for the storage tank. If total solids increase from test to test, the Base Civil Engineer should be notified and the storage tank inspected internally for corrosion or other deposit build-up, and the demineralizer plant checked for operation.

4.5.3 Alternate Sampling and Testing for Bases Not Servicing Water on a Daily or Weekly Basis.. Sample will be drawn and tested as follows:

a. A sample shall be drawn from the fill or drain line once every 7 days and tested for pH.

b. A sample shall be drawn from the fill line once every 30 days and tested for pH and total solids.

4.5.4 Water-Alcohol. When bulk tanks are used for storage of water-alcohol mixtures, a sample of the storage tank contents shall be taken after the addition of each new batch, or every 30 days, whichever is earlier. The contents of the storage tank should be well mixed before the sample is withdrawn. The sample shall be checked for alcohol content with a hydrometer. After being allowed to stand undisturbed for 24 hours, the sample shall be reexamined, visually, for any foreign material (sand, dirt, rust, etc.) that may have settled to the bottom. If sediment is found, indicating a contaminated storage tank, the responsible maintenance personnel shall be informed. Tank shall be inspected internally for corrosion and all tank hatches shall be inspected for closure.

4.5.5 Samples. All samples from storage shall be taken in a manner to insure that the sample is representative of the material to be tested. When corrosion is found in the tank, the tanks shall be cleaned and flushed before being used again.

4.6 DISPENSING EQUIPMENT.

Dispensing equipment (mobile) for water and water-alcohol mixtures utilizes a filter unit ahead of the dispensing hose. Samples shall be taken a minimum of once every 7 days from the dispensing hose after it has been flushed. A minimum of 10 gallons of liquid shall be flushed from the hose before the sample is taken. Flushing of the dispensing hose may be accomplished by recirculating the hose discharge into the servicing tank. Where new, recently issued, demineralized water tanks and tank trucks have been equipped with specifically designed sampling cocks, the sample to be tested may be drawn directly from the sampling cock after 3 gallons of liquid have been flushed through the sampling cock. The water sample will be tested by the base laboratory for total solids that shall be no more than 10 ppm. Water-alcohol mixtures will be tested as outlined in WATER-ALCOHOL MIXTURE, Paragraph 4.3.

4.6.1 Alternate Sampling and Testing for Bases Not Servicing Water on a Daily or Weekly Basis.. Samples will be drawn and tested as follows:

a. A sample shall be taken once every 7 days and tested for pH. This sample may be taken from the manway opening, the sampling cock, or the dispensing hose.

b. A sample shall be taken from the sampling cock or dispensing hose once every 30 days and tested for pH and total solids.

4.6.2 Annual Inspections. The Fuels Quality Control and Refueling Maintenance personnel shall jointly inspect the tank's interior on all dispensing units once every year for corrosion or deposit build-up. This annual inspection shall be visually made to determine the condition of the center compartment. The tanks should be drained completely for an inspection. They should be refilled as soon as possible after the inspection and kept full as much as practical. An aluminum tank partially filled with water will corrode at an accelerated rate. Entry of the tank shall be at the discretion of refueling maintenance personnel and only they shall physically enter the tank. More frequent physical inspections including the aft and forward compartments may be warranted if water quality deteriorates when it has been placed in the tank of the dispensing unit. If tanks are found to contain corrosion or deposit build-up, they shall be cleaned and flushed before reuse. See Chapter 7 for cleaning the A/S32A-2 truck tank. Each annual inspection shall be annotated on AF Form 2420, Quality Control Inspection Summary, or similar, computer-generated form. An AF Form 2419, Routing and Review of Quality Control Report, should also be used to route the annual inspection report through the Fuels Operations Superintendent, Refueling Maintenance Supervisor, Fuels Superintendent, and Fuels Officer. Again, a similar, computer-generated form or forms may be used in place of the AF Forms 2419 and 2420. After routing is completed, the report shall be maintained by the Fuels Quality Control Office. Additionally, the date of inspection and next due date shall be annotated on the vehicle AFTO Form 1807, Operator's Inspection Guide and Trouble Report (Fuel Servicing), and shall be carried forward from month to month.

4.6.3 System Flush After Replacement of Parts. When components such as pumps, filters, piping, hoses, or nozzles are replaced, the dispensing system shall be flushed according to the procedures provided below. In some cases, cleaning and repairing these components may introduce contaminants to the inside of the water dispensing system. The procedure also applies if such contamination is known or suspected.

a. Flush 10 – 50 gallons of demineralized water through the hose.

b. Take a sample from the dispensing hose into a clean, clear glass bottle and check for visual contamination by swirling the sample so that a vortex is formed. The bottle should be cleaned prior to sampling by washing with soap, rinsing with hot water, and rinsing with distilled or demineralized water.

c. Check the strainer for foreign matter.

d. If no contamination is seen in the sample or strainer, place the unit back in service.

e. If contamination is seen, then repeat the procedure.

f. If contamination cannot be removed by flushing, further maintenance will be needed. See the applicable equipment technical manual.

CHAPTER 5
TOTAL SOLIDS IN WATER FOR AIRCRAFT INJECTION SYSTEMS

5.1 SCOPE.

This method describes the gravimetric determination of total solids in water that is to be used in water-alcohol mixtures and water injection systems of jet and reciprocating engine aircraft.

5.2 SAMPLE.

Sample approximately 500 ml of the water to be tested. A minimum of 100 ml is required for test.

5.3 APPARATUS.

a. Hot plate, electric, capable of boiling water.

b. Analytical balance, sensitive to 0.1 mg.

c. Oven, drying, must maintain a temperature of 110° ± 2°C (230° ± 4°F).

d. Pyrex glass evaporating dish 50 ± 5 mm high with a diameter of 90 ± 5 mm.

NOTE

Ribbed watch glasses are no longer manufactured. Glasses on hand should be used but they are no longer required.

e. Watch glass, ribbed, 100 mm diameter.

f. Desiccator, with cover.

g. Glass plate for desiccator.

h. Crucible tongs for transporting evaporating dish.

i. Pipette, 100 ml.

j. Graduated cylinder, 100 ml.

k. Graduated cylinder, 500 ml.

l. Thermometer for temperature measurement at 85°C and 100°C (185°F and 212°F).

m. Safety face mask.

n. Safety gloves.

o. Apron.

p. Containers, with covers, suitable for cleaning glassware and storing the detergent cleaning solution.

q. Funnel, Pyrex.

r. Filter paper, Whatman #42, 11 cm diameter.

s. Beaker, Pyrex, 250 ml.

t. Filtration apparatus for liquid samples with the following component parts:

(1) Filter Holders, Standard Millipore.

(2) Millipore Filters, Type SM (5-micron pore opening) 47 mm Diameter. Millipore, P/N SMWP 047 00 or equivalent.

(3) Petri Dish, 80 mm ID with Covers.

u. Filtering flask.

v. Vacuum system, either aspirator or pump.

w. Forceps, flat-bladed, unserrated for handling filters.

5.4 MATERIALS.

The following materials will be needed to conduct the required tests.

a. Distilled Water (demineralized water may be used as a substitute).

b. Detergent Concentrate (a suggested product is MICRO-90 DETERGENT manufactured by International Products Corp., 201 Connecticut Drive, P.O. Box 70, Burlington, NJ 08016-0070, telephone number (609) 386-8770) or equivalent.

c. Steel Wool, Grade 1 (NSN 5350-00-242-4404, Grade 1).

d. Indicating Desiccant (NSN 6850-00-138-6720).

5.5 PREPARATION OF DETERGENT CLEANING SOLUTION.

a. Place 25 ml of detergent concentrate in a suitable container. Add 1000 ml of distilled water and stir to mix.

b. This solution should be discarded and a fresh solution made monthly. During its use, a small volume of water will be lost due to evaporation; add enough distilled water to bring the volume back to its original size and continue to use. The detergent solution may become cloudy when cold.

The cloudy condition will not affect the cleaning ability.

5.6 CLEANING GLASSWARE.

WARNING

Handling hot items without proper precautions can cause serious burns. Heat resistant gloves shall be worn.

Evaporating dishes used for test should be wiped with a small piece of steel wool on the internal surface to remove dried salts by its abrasive action. The dishes should then be rinsed with tap water before proceeding. Immerse the glassware in the detergent solution for at least 30 minutes. While using the solution for cleaning, it must be maintained at a temperature of 85° ± 5°C (185° ± 9°F). Rinse all glassware with tap water at least three times and then rinse with distilled water at least six times. Ensure that the final rinses with distilled water are thorough. Dry the glassware in dust free oven for at least 2 hours at a temperature of 110° ± 2°C (230° ± 4°F). After removal from the drying oven, place the glass dishes in a desiccator for a minimum of 2 hours prior to use. Glass dishes may be maintained in this condition, ready for test, as long as the indicating desiccant maintains its color.

5.7 PROCEDURE.

a. Weigh glass evaporating dishes to the nearest 0.1 mg. Record the weights and use the lightest dish as the control for determining the blank value.

b. Shake samples to ensure they are homogenous. Pipette 100 ml of each sample into a weighed dish. Using tongs, place the dishes on the hot plate. Cover with ribbed watch glasses. Cover the control dish with a watch glass and place on the desiccator plate (not in the desiccator).

NOTE

Ribbed watch glasses are no longer manufactured. Glasses on hand should be used but they are no longer required.

c. Apply heat to the samples and allow the water to slowly vaporize until approximately 5 ml remain in the dishes. Never allow the water to boil vigorously. Never allow the water to evaporate to dryness in a dish on the hot plate. Place the test and control dishes in the drying oven for 2 hours at a temperature of 110° ± 2°C (230° ± 4°F). Any splashing or bumping that allows drops of water to contact the watch glass will necessitate a retest of the sample.

d. After 2 hours, remove the dishes from the oven and allow to cool in a desiccator for a minimum of 2 hours.

e. Reweigh the dishes and record the weights.

5.8 TEST CALCULATION.

Calculate the total solids content as follows:

a. Total Solids (TS) content in ppm is:

$$TS = [(D - C) - (B - A)] \times 10{,}000$$

Where -

A = Initial weight of control dish in grams.

B = Final weight of control dish in grams.

C = Initial weight of test dish in grams.

D = Final weight of test dish in grams.

b. If the value (B − A) exceeds ±0.0003 grams (0.3 mg), then the testing conditions and/or technique used should be suspect and the samples retested.

5.9 SUSPENDED SOLIDS TEST PROCEDURE.

NOTE

A more accurate method that requires a considerably longer time to perform is to evaporate the entire sample and calculate the total solids from the volume of the sample and the weight of the evaporated residue.

a. If the water sample contains excessive large particles of visible sediment that settle quickly after the sample is shaken, pipetting a sample does not give a representative sample and the following procedure must be used.

b. Record volume of entire sample.

c. Filter entire water sample through a previously dried and weighed 5-micron pore opening Millipore filter, dry filter and reweigh. Calculate the sediment collected in terms of ppm (grams suspended solids x 1000000 ÷ volume of sample in milliliters = sediment in ppm).

d. Determine total solids as outlined in PROCEDURE, Paragraph 5.7 and TEST CALCULATION, Paragraph 5.8.

e. Add total solids value (PROCEDURE, Paragraph 5.7 and TEST CALCULATION, Paragraph 5.8) to suspended solids value to yield total solids value of samples with visible suspended sediment.

CHAPTER 6
MEASUREMENT OF PH

6.1 BUFFERS.

a. Two buffers shall be used to standardize the meter. Use the pH 4 and 7 buffers when the water sample to be measured is acidic. Use the pH 7 and 9 buffers when the water sample to be measured is alkaline. The following buffer powders or their equivalent shall be used to prepare buffer solutions:

pH	Beckman Coulter Part No.	National Stock No.
4.01	3005	6630-00-457-2444
7.00	3007	6630-00-930-6689
9.18	3009	6630-00-671-8141

b. Discard buffers 90 days after preparation. If prepared buffers are used, discard them 90 days after opening.

6.2 CARE AND USE OF ELECTRODES.

When not in use, electrodes should be stored with tips submerged in water. The Potassium Chloride (KCl) solution level of the electrode should be checked periodically and KCl solution added as necessary. Caution must be exercised not to bump or scratch electrode tips.

6.3 PROCEDURE.

a. Allow instrument to warm up for at least 1 hour.

b. For the best results, the buffers, water samples, and electrode should be at the same temperature. A water bath may be used to do this.

c. Standardize the meter according to the manufacturer's instructions using the pH 7 buffer. Discard the contents of the sample cup and refill with fresh buffer after each reading. Repeat until two successive readings are obtained without adjustment of the meter that differ from pH 7.00 by not more than 0.02 units.

d. Check the instrument operation by using the second buffer (pH 4 or 9, see BUFFERS, Paragraph 6.1). If the instrument has a slope control, it may be adjusted to correct the instrument reading for this buffer. Use portions as before until two successive readings are obtained without adjustment of the meter that differs from each other by not more than 0.02 pH units. The meter is working satisfactorily if the readings for the second buffer are within 0.05 pH units of the assigned pH.

e. Measure the pH of the water sample. Use portions as before until two successive readings are obtained that differ from each other by not more than 0.1 pH unit. Several portions of water may be necessary. Record the final value as the pH of the sample.

CHAPTER 7
CLEANING PROCEDURE FOR A/S32A-2 TRUCK TANKS

7.1 SCOPE.

The following procedure is for removal of very thin surface corrosion of A/S32A-2 truck tanks used in demineralized water service. See ANNUAL INSPECTIONS, Paragraph 4.6.2. More severe corrosion or corrosion which cannot be removed by the procedure in this chapter shall be identified by a Quality Deficiency Report submitted to Warner-Robins ALC according to T.O. 00-35D-54, USAF Deficiency Reporting and Investigating System. Submit color photographs if possible.

7.2 RESPONSIBILITY.

The Transportation Vehicle Maintenance Office shall determine whether to contract tank cleaning or to perform tank cleaning using internal resources.

7.3 PROCEDURE.

A two-man policy shall be followed. One person at all times will remain outside of tank and be situated to render immediate aid as required. A safety rope or harness, rubber gloves, apron, rubber boots, eye protection (goggles), and a respirator shall be worn by personnel who enter the tank.

CAUTION

Do not use electrical grinders or other electrical tools in the tank. The use of such tools may lead to damage to the surface of the metal tank.

a. Empty tank contents and clean the tank with one part MIL-PRF-87937, Type IV, (check proper dilution ratio) cleaning compound to seven parts water. A regular mop or wire brush may be used depending on the corrosion.

b. After cleaning, rinse the tank several times with tap water to eliminate all the suds. Use a regular garden hose with sufficient pressure to thoroughly rinse the entire tank. Drain the tank through the main sump after each rinse.

c. Use demineralized water during the final rinse. Fill the tank to capacity, circulate for 30 minutes, and then purge hoses, lines, etc. Drain the tank through the filter separator sump and the main tank sump.

d. After refilling the tank with demineralized water, sample the tank and test the sample for pH and total solids.